CLAIMS

What is claimed is:

1. A method for multi-spectral image capture of a first scene, the method comprising:

acquiring a first series of images of the first scene with one or more image acquisition systems, each of the image acquisition systems having two or more color channels, each of the channels having a different spectral sensitivity; and

filtering each of the first series of images of the scene with a different filter from a set of non-interference filters, each of the non-interference filters in the set of the non-interference filters having a different spectral transmittance.

2. The method as set forth in claim 1 further comprising generating a multi-spectral scene description from the acquired first series of filtered images.

3. The method as set forth in claim 2 further comprising:

acquiring a second series of images of a second scene with the one or more image acquisition systems; and

filtering each of the second series of images of the second scene with a different filter from the set of color filters.

4. The method as set forth in claim 3 further comprising generating a characteristic mapping from the second series of filtered images.

5. The method as set forth in claim 4 further comprising generating a spectral reflectance of the first scene from the multi-spectral scene description and the characteristic mapping.

6. The method as set forth in claim 5 further comprising using the generated spectral reflectance to reproduce the first scene.

7. The method as set forth in claim 5 further comprising storing the generated spectral reflectance for the first scene.

8. The method as set forth in claim 1 further comprising illuminating each image of the first series of images with one or more illuminants.

9. The method as set forth in claim 1 further comprising illuminating each image of the first series of images with an illuminant from a set of two or more illuminants as each of the first series of images is being acquired, each of the illuminants having a different spectral power distribution.

10. The method as set forth in claim 1 wherein the filters in the set of color filters are non-interference filters.

11. The method as set forth in claim 10 wherein at least one of the non-interference filters in the set of color filters is an absorption filter.

12. An apparatus for multi-spectral image capture of a first scene, the apparatus comprising:

one or more image acquisition systems each having two or more color channels, each of the channels having a different spectral sensitivity, each of the image acquisition systems acquiring a first series of images of the first scene; and

a set of non-interference filters, each of the non-interference filters in the set of the non-interference filters has a different spectral transmittance, is positioned between the scene and the image acquisition system, and filters a different image in series of images.

13. The apparatus as set forth in claim 12 further comprising a spectral image processing system which generates a multi-spectral scene description from the acquired first series of filtered images.

14. The apparatus as set forth in claim 13 wherein the image acquisition systems acquire a second series of images of a second scene and the set of color filters filter each of the second series of images of the second scene with a different filter.

15. The apparatus as set forth in claim 14 wherein the spectral image processing system generates a characteristic mapping from the second series of filtered images.

16. The apparatus as set forth in claim 15 wherein the spectral image processing system generates a spectral reflectance of the first scene from the multi-spectral scene description and the characteristic mapping.

17. The apparatus as set forth in claim 16 further comprising a printing device to reproduce the first scene based on the generated spectral reflectance.

18. The apparatus as set forth in claim 16 further comprising a memory device for storing the generated spectral reflectance for the first scene.

19. The apparatus as set forth in claim 12 further comprising one or more illuminants which illuminate each image of the first series of images.

20. The apparatus as set forth in claim 12 further comprising a set of two or more illuminants, each of the illuminants having a different spectral power distribution and illuminating one of the images of the first series of images.

21. The apparatus as set forth in claim 12 wherein the filters in the set of color filters are non-interference filters.

22. The apparatus as set forth in claim 21 wherein at least one of the non-interference filters in the set of color filters is an absorption filter.

23. A method for multi-spectral image capture of a first scene, the method comprising:

providing two or more image acquisition systems, each of the image acquisition system having at least one spectrally unique color channel; and

acquiring a first series of images of the first scene, each of the images of the first series of images is acquired with a different one of the image acquisition systems.

24. The method as set forth in claim 23 further comprising generating a multi-spectral scene description from the acquired first series of filtered images.

25. The method as set forth in claim 24 further comprising acquiring a second series of images of a second scene with the two or more image acquisition systems, each of the images of the second series of images is acquired with a different one of the image acquisition systems.

26. The method as set forth in claim 25 further comprising generating a characteristic mapping from the second series of filtered images.

27. The method as set forth in claim 26 further comprising generating a spectral reflectance of the first scene from the multi-spectral scene description and the characteristic mapping.

28. The method as set forth in claim 27 further comprising using the generated spectral reflectance to reproduce the first scene.

29. The method as set forth in claim 27 further comprising storing the generated spectral reflectance for the first scene.

30. An apparatus for multi-spectral image capture of a first scene, the apparatus comprising:

two or more image acquisition systems;

each of the image acquisition system having at least one spectrally unique color channel; and

each image of the first series of images being acquired with a different one of the image acquisition systems.

31. The apparatus as set forth in claim 30 further comprising a spectral image processing system which generates a multi-spectral scene description from the acquired first series of filtered images.

32. The apparatus as set forth in claim 31 wherein the image acquisition systems acquire a second series of images of a second scene.

33. The apparatus as set forth in claim 32 wherein the spectral image processing system generates a characteristic mapping from the second series of images.

34. The apparatus as set forth in claim 33 wherein the spectral image processing system generates a spectral reflectance of the first scene from the multi-spectral scene description and the characteristic mapping.

35. The apparatus as set forth in claim 34 further comprising a printing device to reproduce the first scene based on the generated spectral reflectance.

36. The apparatus as set forth in claim 34 further comprising a memory device for storing the generated spectral reflectance for the first scene.

37. A method for multi-spectral image capture of a first scene, the method comprising:

acquiring a first series of images of the first scene with one or more image acquisition systems, each of the image acquisition systems having two or more color channels, each of the channels having a different spectral sensitivity; and

illuminating each image of the first series of images with a different illuminant from a set of two or more illuminants, each illuminant having a different spectral power distribution.

38. The method as set forth in claim 37 further comprising generating a multi-spectral scene description from the acquired first series of filtered images.

39. The method as set forth in claim 38 further comprising:

acquiring a second series of images of a second scene with the one or more image acquisition systems; and

illuminating each of the second series of images of the second scene differently.

40. The method as set forth in claim 39 further comprising generating a characteristic mapping from the second series of filtered images.

41. The method as set forth in claim 40 further comprising generating a spectral reflectance of the first scene from the multi-spectral scene description and the characteristic mapping.

42. The method as set forth in claim 41 further comprising using the generated spectral reflectance to reproduce the first scene.

43. The method as set forth in claim 42 further comprising storing the generated spectral reflectance for the first scene.

44. An apparatus for multi-spectral image capture of a first scene, the apparatus comprising:

an image acquisition system having two or more color channels, each of the color channels having a different spectral sensitivity; and

a set of two or more illuminants, each illuminant having a different spectral power distribution and illuminating one of the images of the first scene.

45. The apparatus as set forth in claim 44 further comprising a spectral image processing system which generates a multi-spectral scene description from the acquired first series of filtered images.

46. The apparatus as set forth in claim 45 wherein the image acquisition systems acquire a second series of images of a second scene and the set of color illuminants illuminate each of the second series of images of the second scene with a differently.

47. The apparatus as set forth in claim 46 wherein the spectral image processing system generates a characteristic mapping from the second series of illuminated images.

48. The apparatus as set forth in claim 47 wherein the spectral image processing system generates a spectral reflectance of the first scene from the multi-spectral scene description and the characteristic mapping.

49. The apparatus as set forth in claim 48 further comprising a printing device to reproduce the first scene based on the generated spectral reflectance.

50. The apparatus as set forth in claim 48 further comprising a memory device for storing the generated spectral reflectance for the first scene.

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51. A method for estimating spectral reflectances comprising:

obtaining samples of known spectral reflectances which are representative of colorants of a first scene;

acquiring a first multi-spectral description of the first scene from the samples;

deriving a transformation which maps channels of the first multi-spectral description of the first scene back to the known spectral reflectances;

acquiring a second multi-spectral description of a second scene; and

applying the transformation to the second multi-spectral description of the second scene and generating spectral reflectances of the second scene.

52. The method as set forth in claim 51 further comprising normalizing and adjusting signals in the first multi-spectral description to keep a photometric linear relationship.

53. The method as set forth in claim 51 wherein the transformation is performed in spectral reflectance space.

54. The method as set forth in claim 51 wherein the transformation is performed in absorption space.

55. The method as set forth in claim 51 wherein the transformation is performed in a new optimized space.

56. The method as set forth in claim 55 wherein the new optimized space is optimized to derive multi-variate normality of samples or improve spectral estimation accuracy.

57. The method as set forth in claim 51 wherein a direct matrix transformation from digital counts to the spectral reflectances is derived.

58. The method as set forth in claim 51 wherein a Wiener estimate transformation from digital counts to the spectral reflectances is derived.

59. The method as set forth in claim 58 wherein the Wiener estimate transformation accounts for noise information.

60. The method as set forth in claim 51 wherein an eigenvector analysis is used to derive the transformation.

61. A system for estimating spectral reflectances comprising:

samples of known spectral reflectances which are representative of colorants of a first scene;

at least one image acquisition system which obtains a first multi-spectral description of the first scene from the samples and a second multi-spectral description of a second scene; and

a spectral image processing system that derives a transformation which maps channels of the first multi-spectral description of the first scene back to the known spectral reflectances and applies the transformation to the second multi-spectral description of the second scene to generate spectral reflectances of the second scene.

62. The system as set forth in claim 61 wherein the spectral image processing system normalizes and adjusts signals in the first multi-spectral description to keep a photometric linear relationship.

63. The system as set forth in claim 61 wherein the transformation is performed in spectral reflectance space.

64. The system as set forth in claim 61 wherein the transformation is performed in absorption space.

65. The system as set forth in claim 61 wherein the transformation is performed in a new optimized space.

66. The system as set forth in claim 65 wherein the new optimized space is optimized to derive multi-variate normality of samples or improve spectral estimation accuracy.

67. The system as set forth in claim 61 wherein the spectral image processing system derives a direct matrix transformation from digital counts to the spectral reflectances.

68. The system as set forth in claim 61 wherein the spectral image processing system derives a Wiener estimate transformation from digital counts to the spectral reflectances.

69. The system as set forth in claim 68 wherein the Wiener estimate transformation accounts for noise information.

70. The system as set forth in claim 61 wherein the spectral image processing system uses an eigenvector analysis to derive the transformation.